AP Physics – Thanks for the Homework – 2

1. A race car accelerates from rest to a speed of 287 km/h in 6.8 seconds. What is its average acceleration?

$a = \frac{v}{t}$ $a = 287\frac{km}{h}\left(\frac{1}{6.8\,s}\right)\left(\frac{1000\,m}{1\,km}\right)\left(\frac{1\,h}{3\,600\,s}\right) =$ $\boxed{12\frac{m}{s^2}}$

2. The space shuttle undergoes an acceleration of 53.9 m/s^2. How fast is it traveling at the end of 55.2 s?

$a = \frac{v}{t}$ $v = at$ $v = \left(53.9\frac{m}{s^2}\right)(55.2\,s) =$ $\boxed{2\,980\frac{m}{s}}$

3. Can an object under constant acceleration come to rest and stay at rest? Explain your answer.

4. You are in an elevator that is accelerating you upward at 4.55 m/s^2. How much time till you are traveling at 11.0 m/s?

$a = \frac{v}{t}$ $t = \frac{v}{a}$ $t = 11.0\frac{m}{s}\left(\frac{1}{4.55\frac{m}{s^2}}\right) = 2.42\,s$

5. Two cars travel in the same direction along a straight highway, one at a constant speed of 55 mi/h and the other at 70.0 mi/h. (a) Assuming that they start at the same point, how much sooner does the faster car arrive at a destination 10. miles away? (b) How far must the faster car travel before it has a 15 minute lead on the slower car?

(a) $v = \frac{d}{t}$ $t_1 = 10.\,mi\left(\frac{1}{70.\frac{mi}{h}}\right) = 0.143\,h$ $t_2 = 10.\,mi\left(\frac{1}{55.\frac{mi}{h}}\right) = 0.182\,h$

Time difference: $0.182h - 0.143\,h = 0.039\,h$ $0.039\,h\left(\frac{60\text{ min}}{1\,h}\right) = 2.3\text{ min}$

(b) 15 min lead -- ahead by distance equal to that traveled by slower car in 15 min.

$15\text{ min}\left(\frac{1\,h}{60\text{ min}}\right) = 0.25\,h$

$v = \frac{d}{t}$ $d = vt$ $d = \left(55.\frac{mi}{h}\right)(0.25\,h) = 13.75\,mi$

rel speed: $70\frac{mi}{h} - 55\frac{mi}{h} = 15\frac{mi}{h}$ time to get ahead by 13.75 mi is:

$t = \frac{d}{v}$ $= 13.75\,mi\left(\frac{1}{15\frac{mi}{h}}\right)$ $=$ $0.9167\,h$

Distance traveled: $d = vt$ $d = 70.\frac{mi}{h}(0.9167\,h) =$ $\boxed{64\,mi}$

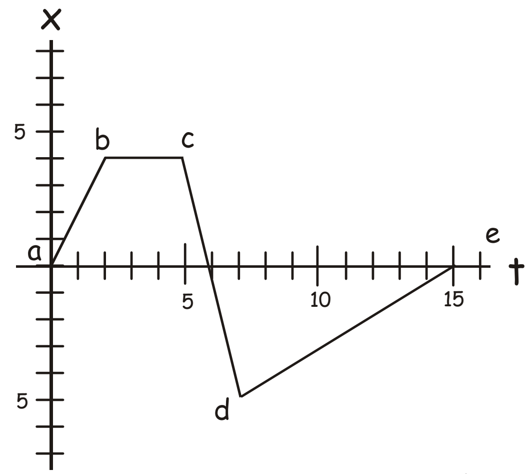
6. A car traveling in a straight line has a velocity of + 5.0 m/s at some instant. After 4.0 s, its velocity is + 8.0 m/s. What is its average acceleration during this time interval?

$a = \frac{\Delta v}{t}$ $a = \left(8.0\frac{m}{s} - 5.0\frac{m}{s}\right)\left(\frac{1}{4.0\,s}\right) =$ $\boxed{0.75\frac{m}{s^2}}$

7. A car is traveling at 108 km/h, stuck behind a slower car. Finally the road is clear and the car pulls over to make a pass. The driver stomps on the gas pedal and accelerates up to a speed of 135 km/h. If it took 3.5 s to reach this speed, what is the average acceleration?

$$a = \frac{\Delta v}{t} \qquad a = \left(135\frac{km}{h} - 108\frac{km}{h}\right)\left(\frac{1}{3.5\ s}\right)\left(\frac{1000\ m}{1\ km}\right)\left(\frac{1\ h}{3\,600\ s}\right) = \boxed{2.14\frac{m}{s^2}}$$

8. A position vs time graph is shown to the right. Please analyze the graph and determine the following. (a) The speed of the object from b → c, (b) the speed from c → d, (c) the speed from d → e, (d) the times ***t*** when the speed of the object is zero, and (e) the points where the direction of the object had to change (if any).



Position Time Graph

(a) $v_{bc} = 0$

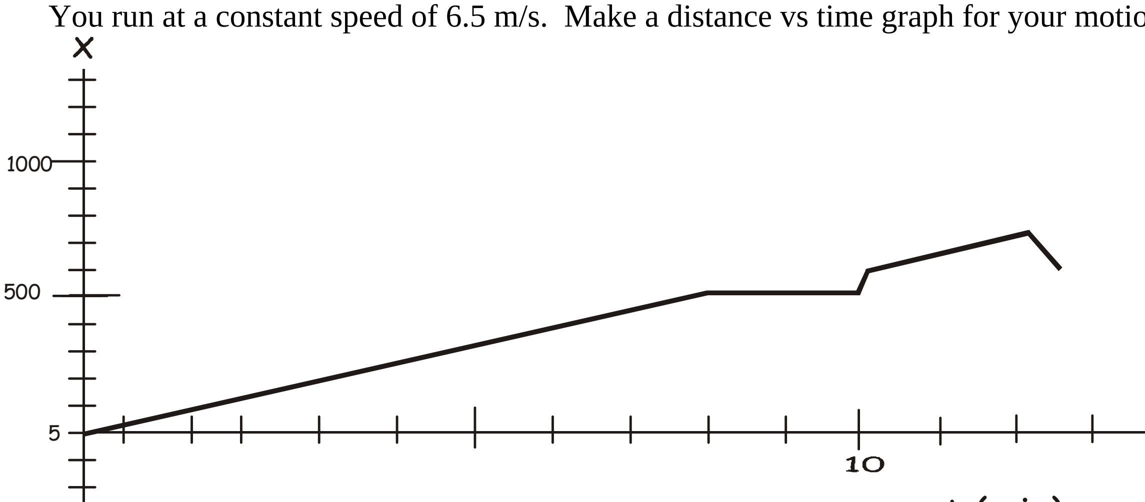
(b) $v_{cd} = \frac{-5\ m - 4\ m}{7\ s - 5\ s} = -4.5\frac{m}{s}$

(c) $v_{de} = \frac{0\ m - (-5\ m)}{15\ s - 7\ s} = 0.62\frac{m}{s}$

(d) b – c,

(e) (maybe) a, c, d, (maybe) e

9. You walk down the sidewalk to the east for 8.0 min at a speed of 1.2 m/s. You reach a busy street and have to stop. You remain at rest for 2 minutes. The traffic dies down, so you run across the street at constant speed. The street is 12 m wide and it takes you 1.5 s to cross it. You immediately slow down to your regular 1.2 m/s walk speed and proceed for 2 min. You suddenly discover that your plush ducky fell off your backpack. You immediately turn around and run back to the intersection you just crossed. You run at a constant speed of 6.5 m/s. Make a distance vs time graph for your motion.



Position Time Graph

$$v = \frac{x}{t} \quad x = vt \quad 1.2\frac{m}{s}(8\ min)\left(\frac{60\ s}{1\ min}\right) = 576\ m \qquad x = 1.2\frac{m}{s}(2\ min)\left(\frac{60\ s}{1\ min}\right) = 144\ m$$

$$576\ m + 12\ m + 144\ m = 732\ m$$

$$v = \frac{x}{t} \quad t = \frac{x}{v} \quad 144\ m\left(\frac{1}{6.5\frac{m}{s}}\right)\left(\frac{1\ min}{60\ s}\right) = 0.37\ min$$